separated than is found in most species of *Adenophorus*, and mostly glabrous leaf lamina (vs. lamina with varying densities of glandular hairs in *Adenophorus*). Molecular phylogenetic evidence, however, provides robust support for a sister-taxon relationship between *G. tenella* and the *Adenophorus* clade (Ranker *et al.*, 2003; Ranker *et al.*, 2004). Phylogenetic analyses of sequence variation for the plastid genes *rbcL* and *atpß* supported this sister-taxon relationship with 98% parsimony bootstrap support, 1.0 posterior probability Bayesian support, and Bremer support of 7 steps. The well-supported sister group to the *G. tenella* + *Adenophorus* clade includes the monophyletic black-margined *Grammitis* spp. as sister to the monophyletic genus *Cochlidium* Kaulf. Neither of the latter two groups possess glandular, receptacular paraphyses. Thus, even though glandular paraphyses of varying morphology occur in a diversity of grammitid taxa, their presence in *G. tenella* and *Adenophorus* spp. serves as a synapomorphy for that combined clade. Because of this shared feature of glandular, receptacular paraphyses and in light of the highly robust molecular phylogenetic data, I propose the following combination in *Adenophorus*.

Adenophorus tenellus (Kaulf.) Ranker, ***comb. nov.***– *Grammitis tenella* Kaulf., Enum. Filic. 84. 1824. TYPE.—OWahu insularum Sandwich., Chamisso *s.n.* (holotype, LE; photo of holotype at BISH!).

Specimens examined at BISH: HAWAIIAN ISLANDS: **Kaua'i**: 1895, *A. A. Heller 2215*; 1917, *C. N. Forbes 1705K*; 1969, *J. Henrickson 4001*; 1955, *B. C. Stone 796*; *1960, B. C. Stone 3343*; 1983, *W. Takeuchi Alakai_192*. **O'ahu**: 1923, *D. L. Topping 2647*; 1984, *W. Takeuchi Koolau_30*; 1930, *H. St. John 10615*; 1932, *H. St. John 11688*; 1932, *H. St. John 12220*; 1990, *T. A. Ranker et al. 1098*; 1933, *F. R. Fosberg 9429*; 1951, *A. K. Chock 206*. **Moloka'i**: 1948, *H. St. John 23419*; 1987, *D. H. Lorence 5469*. **Lana'i**: 1915, *G. C. Munro 470*; 1935, *F. R. Fosberg 12487*; 1963, *O. & I. Degener 30152*. **Maui**: 1984, *R. Hobdy 1990*; 1976, *P. K. Higashino & G. Mizuno 3098*. **Hawai'i**: 1954, *H. St. John 25395*; 1990, *T. A. Ranker 1117*; 1989, *T. A. Ranker 996*; 1980, *F. R. Fosberg 60552*; 1995, *K. R. Wood 4723*.—Tom A. Ranker, Department of Botany, University of Hawai'i at Manoa, 3190 Maile Way, St. John 101, Honolulu, HI 96822.

Range Expansion of Two Tropical to Subtropical Ferns, Ladder Brake (*Pteris vittata* L.) and Lace Fern (*Microlepia strigosa* (Thunb. ex Murray) K. Presl.), in the Urban Osaka Bay Area, Western Japan.—Murakami *et al.* (Amer. Fern J. 97(4):12–24. 2007) reported the clear northward local range shift of the greenhouse weed *Thelypteris dentata* (Forssk.) St. John as an example of range expansion of a tropical species. They estimated this species' dispersal rate as approximately 60 to 100 km over 20 years, or 3 to 5 km per year. This remarkable northward expansion may be rare, but two other tropical to

subtropical ferns have shown a similar pattern in the Osaka Bay area, as described here.

Ladder brake (*Pteris vittata* L.) and lace fern (*Microlepia strigosa* (Thunb. ex Murray) K. Presl.) grow extensively in subtropical and tropical regions of Japan. Kurata and Nakaike reported the distributions of these species in Japan (*Illustrations of Pteridophytes of Japan Vol. 1.* pp. 170–178, 260–263. Univ. Tokyo Press, Tokyo. 1979). *Pteris vittata* was distributed mainly in southern Kyushu and sparsely in the Osaka Bay area. *Microlepia strigosa* was distributed mainly near sea level in Kyushu, Shikoku, and southern Honshu, and at some localities in the Osaka Bay area: southernmost Osaka, southern and eastern Awaji Island, and Nishinomiya city. However, their distributions have not been reported in detail since 1979, apart from that of *P. vittata* in Wakayama Prefecture (Yamamoto, Ferns and Mosses 16:17–19. 2000).

Figures 1 and 2 show the localities of *P. vittata* and *M. strigosa* in the Osaka Bay area from 1959 through 2007. The new localities, nos. 2 and 3 (Kasukade-kita and Nishijima, Konohana-ku, Osaka-shi), in Fig. 1 are the first records of *P. vittata* in Osaka Prefecture. Three new populations of *M. strigosa* were discovered at Fukumachi and Suminoe (in Osaka city) and Izumisano (nos. 1, 4, and 6 in Fig. 2) in the autumn of 2006, and survived until the autumn of 2007. We could not determine whether the other populations of *P. vittata* and *M. strigosa* survived the winter of 2006 because we found them only after the spring of 2007. However, the populations at nos. 2 and 3 in Fig. 1 and at nos. 5 and 6 in Fig. 2 had a large number of full-grown individuals. The main habitats of the newly discovered populations of *P. vittat*a and *M. strigosa* were hard-surfaced, human-made habitats such as stone walls, road-side walls or the bottom of drainage channels or alleys between buildings (Fig. 3). Our results show a range expansion of these two species since the previous records. However, the distance of northward shift was shorter or unclear compared with that of *T. dentata* (Murakami *et al.*, 2007).

In Honshu, the first occurrence of *Pteris vittata* was documented in the 1950s in Kinki District, southern Wakayama Prefecture (Tagawa, *Colored Illustrations of the Japanese Pteridophyta*, p. 57. Hoikusha, Tokyo. 1959). Yamamoto (2000) plotted the records of *P. vittata* since 1959 in Wakayama Prefecture. The distribution gradually extended to the outskirts of Shirahama-cho from 1970 to 1980, but remained limited. In the 1990s, new localities of *P. vittata* were reported in succession in Wakayama city, 80 km north of Shirahama in the northernmost part of the prefecture, and in Ryujin-mura, 60 km north of Shirahama (Yamamoto, 2000). Until now, *P. vittata* has not been reported in Osaka Prefecture, which adjoins the northern boundary of Wakayama city. In other districts, new populations of *P. vittata* were reported in Takaraduka city, Hyogo Prefecture (Yamazumi, Newsl. Kinki Bot. Soc. 59:13–14. 1993), 10 km northwest of Osaka; Anjoh city, Aichi Prefecture (Hotta, J. Nippon Fernist Club 3:414–415. 1997), 150 km east of Osaka; Yokohama city, Kanagawa Prefecture (Flora-Kanagawa Association, *Flora of Kanagawa*, p. 50. Kanagawa Pref. Mus. Nat. Hist., Odawara. 2001; Hayashi, *Flora Kanagawa* 63:785. 2007), 370 km east of Osaka. This spread in

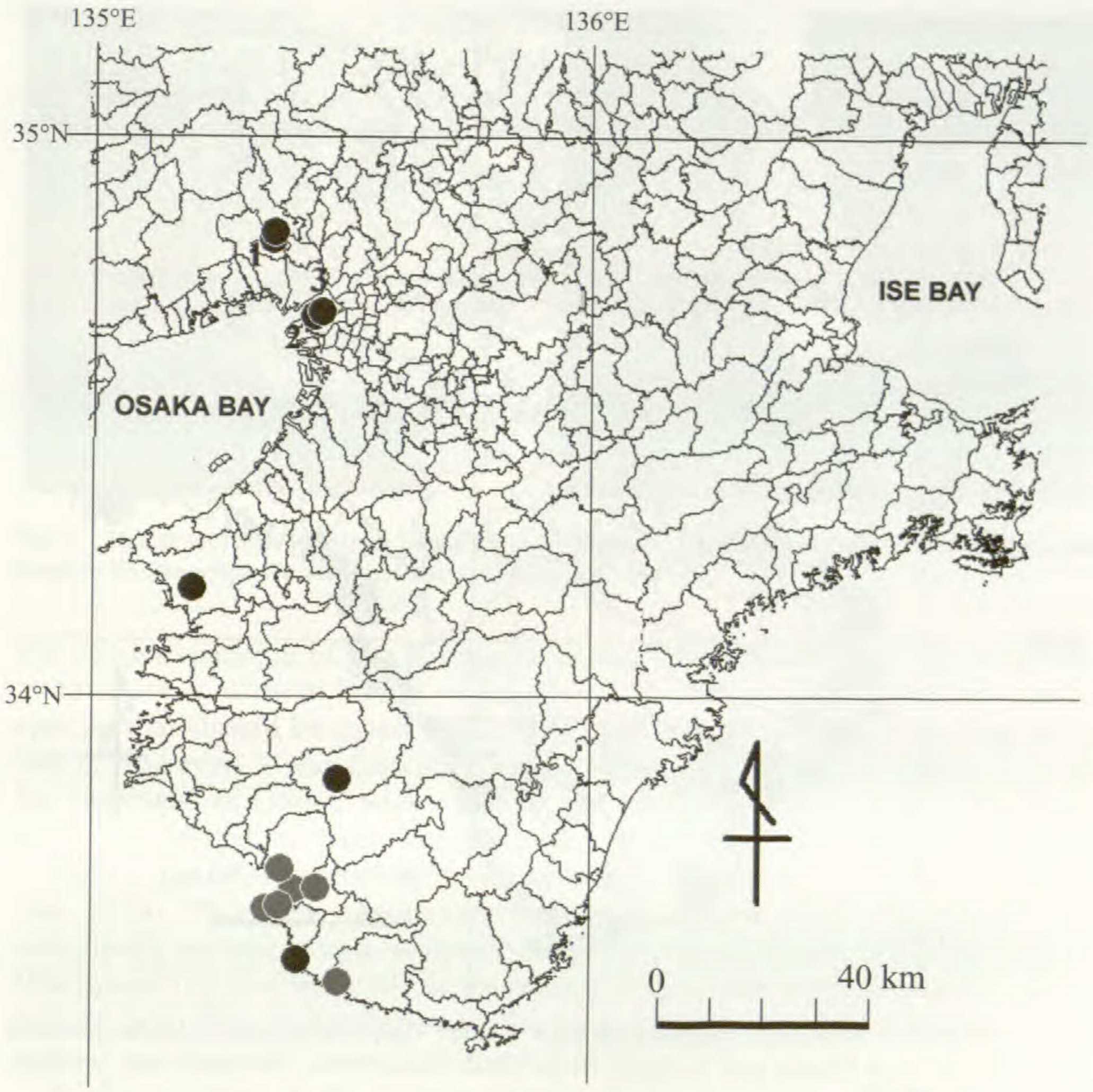

FIG. 1. Records of *Pteris vittata* from 1975 to 2007. Gray circles mark localities recorded from 1975 to 1987 (Kurata and Nakaike, 1979; Nakajima *et al.* A list of pteridophyte specimens collected by Mr. Hisaya Manago in Wakayama Prefecture, p. 38. Osaka Museum of Natural History, Osaka. 1997). Black circles mark localities recorded in the 1990s (Yamazumi, 1993; Yamamoto, 2000) to 2007. Numbers 1 through 3 mark new localities recorded in 2006–07.

distribution of *P. vittata* is similar to that of the alien fern *T. dentata* (Murakami *et al.*, 2007). The first occurrence of *T. dentata* was recorded in the 1950s in Kinki District (Yamazumi, Newsl. Kinki Bot. Soc. 45:13–14. 1988). After Manago (Nanki Seibutsu 28:93–96. 1986) reported detailed observations of the ecology of *T. dentata* and its range expansion in Wakayama Prefecture, this species was reported in succession in Osaka Prefecture (Yamazumi, 1988), Chiba Prefecture (Nakaike, J. Nippon Fernist Club 3(6):128. 1996), Kanagawa Prefecture (Hiratsuka City Museum, *Shohnan shokubutsu-shi VI*, p. 13. Hiratsuka City Museum, Hiratsuka. 2001), and Aichi Prefecture (Hotta, Rep.

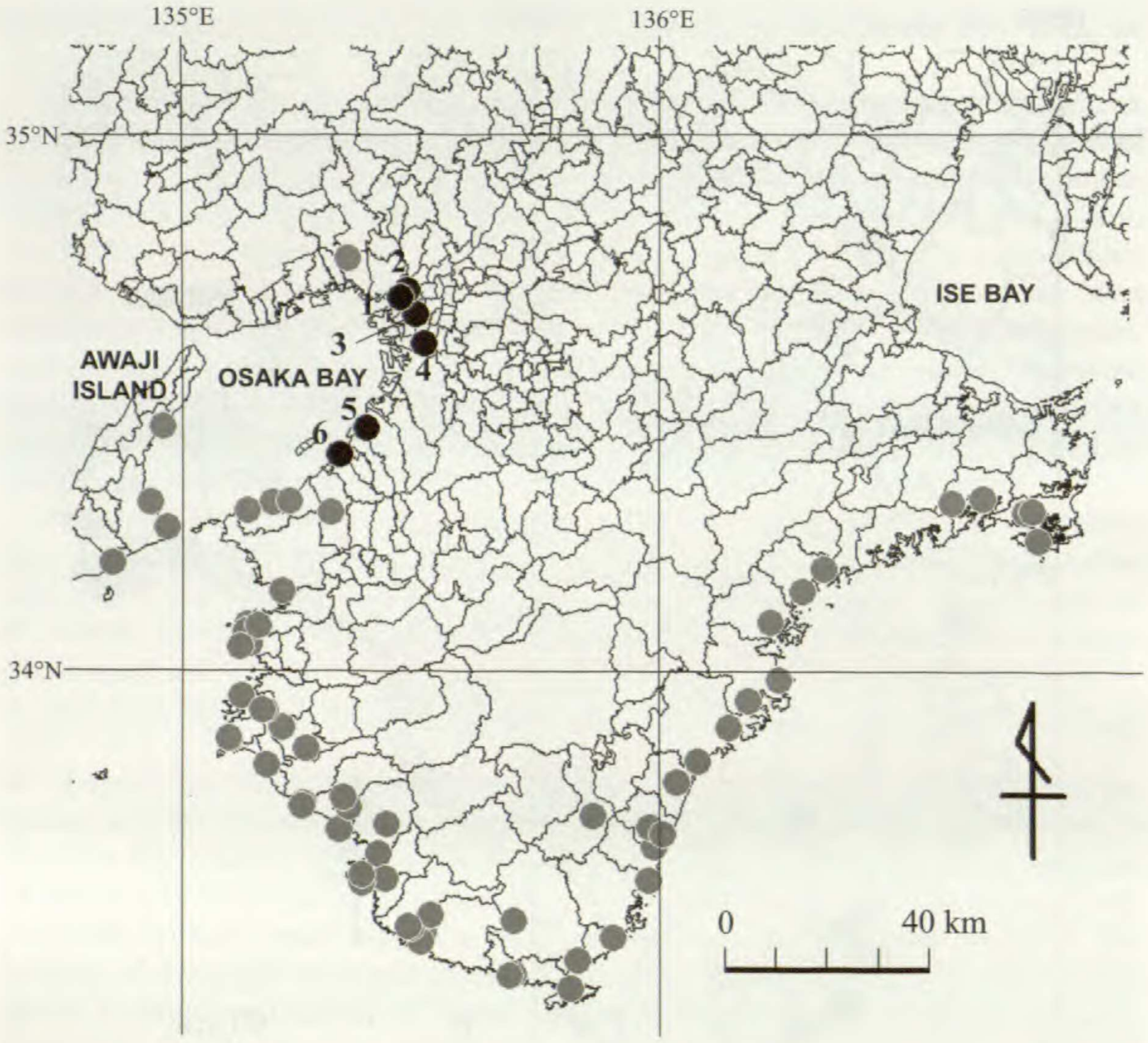

FIG. 2. Records of *Microlepia strigosa* from 1959 to 2007. Gray circles mark localities recorded from 1959 to 1978 (Kurata and Nakaike, 1979). Black circles (nos. 1–6) mark new localities recorded in 2006–07.

Anjo City Mus. Hist. 4:133–144. 2001). *Pteris vittata* was also recorded in all of these prefectures except Chiba. Climate warming in urban areas due to the urban heat island effect, global warming, or both may relate to these range expansions, as discussed by Murakami *et al.* (2007). Since both *T. dentata* and *P. vittata* grow on stone walls and gutters, a nonbiological urban matrix will not necessarily hinder their range expansion. Urban roads or concrete warmed by the heat island effect may assist the growth of these tropical weedy ferns. However, newly recorded *P. vittata* individuals may have escaped from greenhouses or homes (Yamamoto, 2000). Tagawa (1959) suggested that *P. vittata* in southern Kinki District is not native to Wakayama, and Yamamoto (2000) agreed. Thus, the range expansion of these species may be caused not simply by urban temperature rise, but also by escape from cultivation.

Microlepia strigosa is an indigenous species found along the south coast of Honshu and further south. Until this report, there was no domestic report of

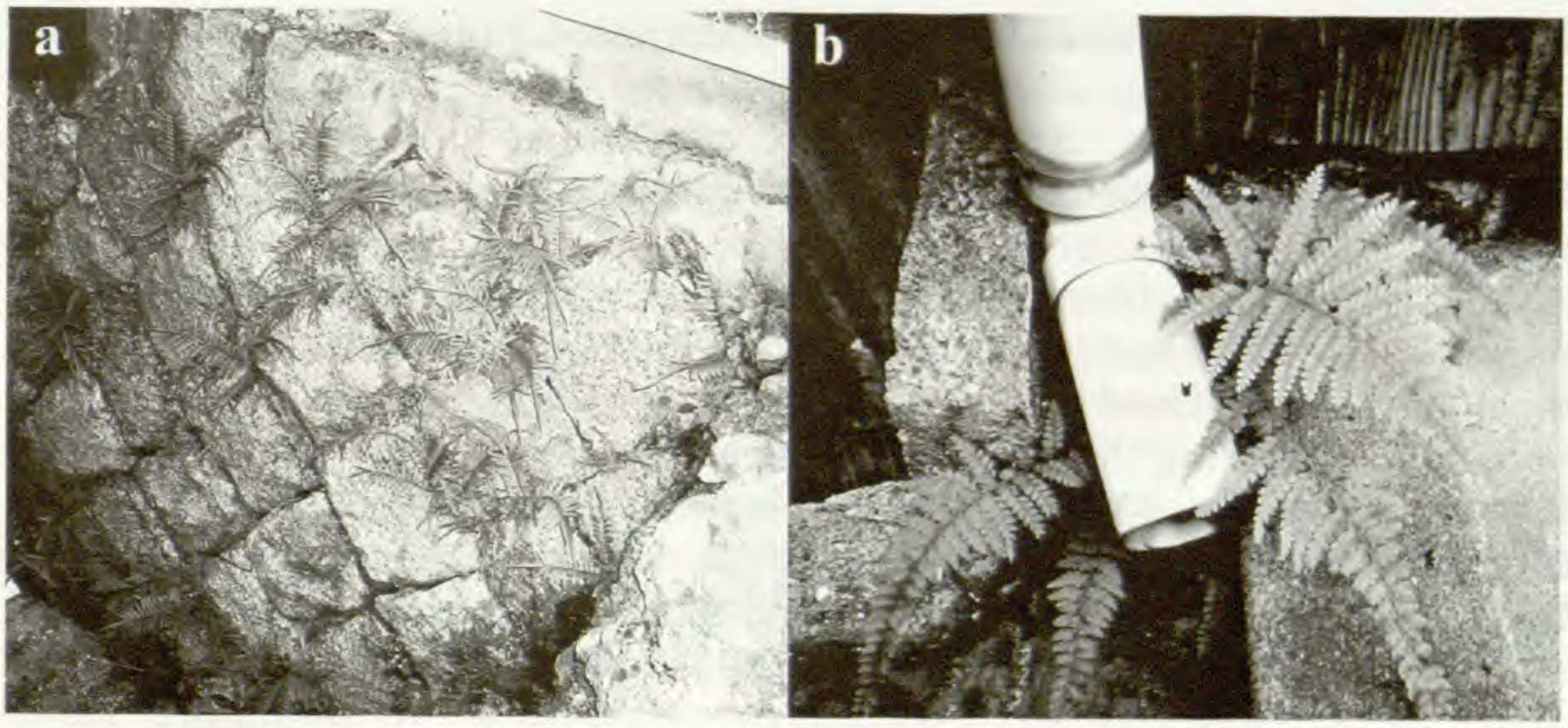

FIG. 3. Habitat of *Pteris vittata* (a: Nishijima, Konohana-ku, Osaka-shi, Osaka Pref.) and *Microlepia strigosa* (b: Sangenya, Taisho-ku, Osaka-shi, Osaka Pref.).

the range expansion of this species in Japan. There was also no report of it as an invasive species; in the Hawaiian Islands, *M. strigosa* is regarded as a native species that should be conserved (Tickin *et al.*, Biodiv. Conserv. 16:1633–1651. 2006). However, it was discovered in an urban wildlife park in Kyoto city, 30 km northeast of Osaka, where it does not naturally occur; those individuals were considered to have been introduced as cultivated plants or in the introduced soil (Murakami *et al.*, J. Japanese Revegetation Technology. 30:139–144. 2004). Thus, the range expansion of *M. strigosa* cannot be judged as a completely natural event. As the discontinuity in its current distribution from Wakayama city to Osaka city is decreasing (Fig. 1) and considering the role of human activities in its dispersal, the range expansion of *M. strigosa* in this region appears to be a reasonable conclusion.

As the survival of *M. strigosa* during winter in Osaka city has not been investigated to date, except in Suminoe and Fukumachi, studies are warranted. However, in the wildlife park in Kyoto city, where the average temperature and annual lowest temperature are lower than those in Osaka city, *M. strigosa* arrived and grew for at least 4 years (2002 to 2005) (Murakami, *in* Morimoto, Y. and Y. Natuhara, eds. *Living Forest*, pp. 83–100. Kyoto Univ. Press, Kyoto. 2005). Therefore, *M. strigosa* can grow adequately at the present air temperature in Osaka city.

In the case of alien species such as *T. dentata*, it may be that they expanded their range naturally because of inherent potential, not because of the influence of climate change. However, we believe that it is reasonable to consider the change in the northward distribution of native species like *M. strigosa* as a response to climate change. Therefore, although cultivated plants or introduced soil could lead to naturalization, the range expansion of *M. strigosa* should be interpreted as an example of range expansion due to climate warming. A similar judgment may not be appropriate for *P. vittata*, which is

probably an alien species. Despite the restricted range expansion of this species for some time after its first discovery in the 1950s in Wakayama Prefecture (Yamamoto, 2000), the later increase in localities (Hotta, 1997; Yamamoto, 2000; Yamazumi, 1993) should be considered the result of climate warming.

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***Marsilea mutica* in Maryland.**—*Marsilea mutica* Mett. has previously been reported from Virgina (Knepper *et al.*, Amer. Fern J. 92(3):243–244. 2002.) South Carolina, Georgia, Oklahoma, Louisiana, Alabama, Mississippi, and Florida (www.cars.gov/Region-5-Report/html/emergent_plants.html). In August 2006 Arnold (Butch) Norden of the Maryland Department of Natural Resources reported to me that he had seen a water clover along the edge of a pond in Charles County, Maryland, although he did not know which species.

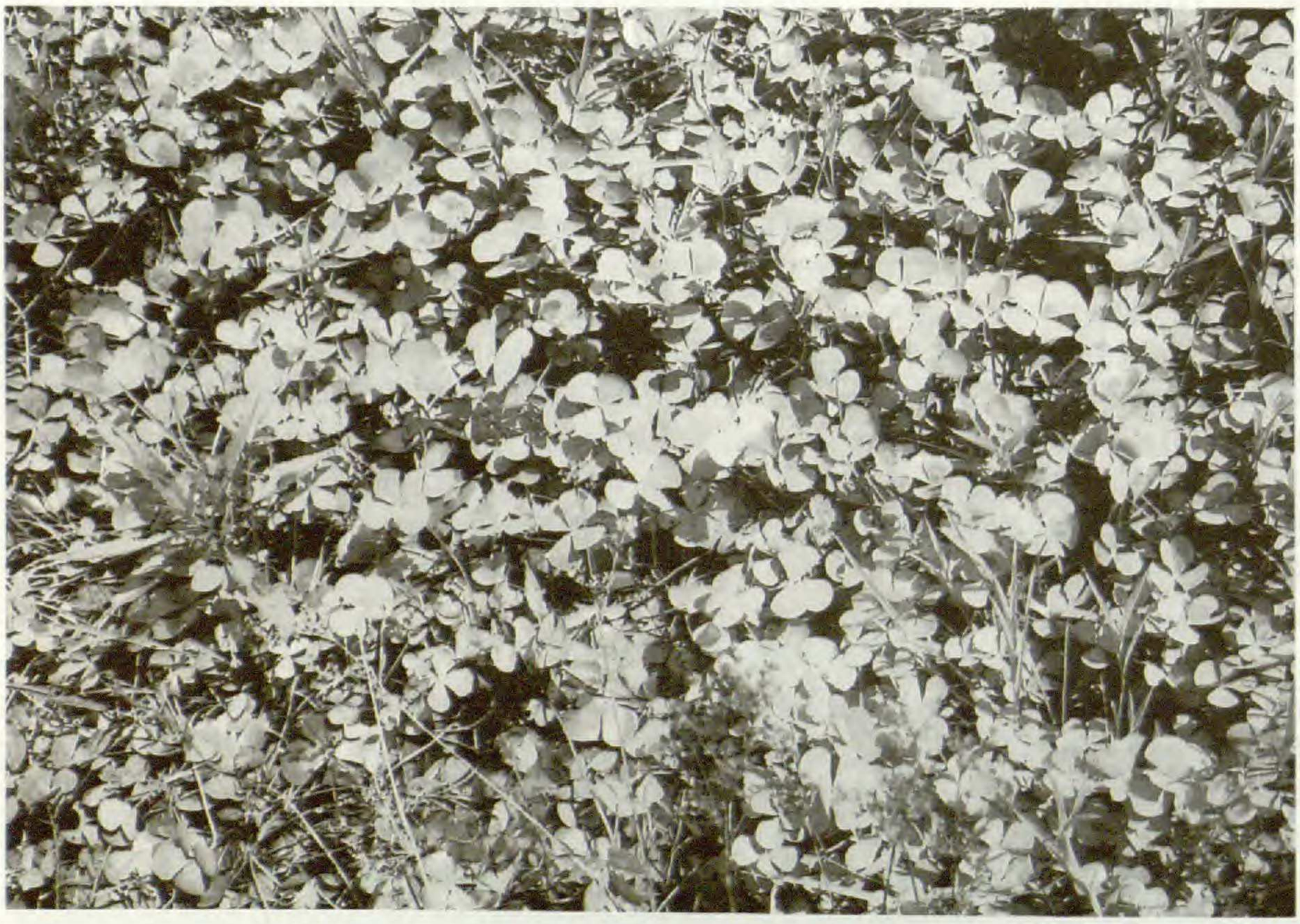

FIG. 1. Dense colony of *Marsilea mutica*.